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Engineer Preparation of Positions of Missile Units

Engineer preparation of the terrain and of positions for missile units is carried out with the object of ensuring convenience of delivery of fire and control, speed of maneuver, concealed disposition, and the protection of the personnel and equipment from enemy means of destruction.

The degree and nature of the engineer preparation depends on the time and materials available, the nature of the terrain, the time of year, and also on the reinforcement of the missile units by combat engineer subunits and equipment for carrying out the engineer work mechanically.

Engineer preparation of the terrain is carried out, as a rule, in a definite sequence. The sequence of the work is laid down by the commander in accordance with the situation, manpower available, time, mechanized equipment, and materials. In all cases during the preparation of the siting areas (positsionnyy rayon), first priority should be given to the carrying out of work without which it would be impossible to prepare for launching and to launch the missiles, and as second priority - everything else.

The basic extent of the engineer work includes the preparation of concentration areas, approach routes, and especially the siting areas.

In this article are given the basic conditions (polozheniye) concerning the engineer preparation in the concentration areas of missile units, recommendations are given for engineer preparation of siting areas, as well as a brief examination of the basic features of the engineer preparation of the terrain for these units in mountainous and winter conditions.

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Engineer Preparation of the Terrain in the Concentration Areas

The basic tasks of engineer preparation of the terrain in the concentration areas of missile units are:

-camouflage of combat and transport equipment using materials at hand and organic camouflage material;

-the preparation of cross-country routes in the concentration areas and for moving out equipment on to the main route;

-construction of covered positions for personnel;

-preparation of command posts;

-construction of cover of the dugout type for special equipment (in the absence from the terrain of natural cover and camouflage);

-preparation of positions for self-defense;

-preparation of water supply points.

As the stay of the troops in the concentration area is of short duration, the volume of engineer preparation work done must be the minimum necessary.

When selecting the concentration areas, in order to reduce the volume of engineer work, it is necessary to make maximum use of the camouflage and protective characteristics of the terrain, of the existing approach routes and roads, and also take into account the possibility of organizing protection and self-defense with a minimum expenditure of forces and weapons.

To ensure protection against enemy means of destruction, the subunits in the concentration area must be dispersed over the terrain (by batteries). The distance between the batteries must be not less than 1 to 2 kilometers.

On occupation of the concentration area, as first priority, a concealed disposition of combat and transport equipment is carried out with the maximum use of natural cover and camouflage, and roads also are prepared for a quick exit of the equipment to the main route to proceed to the launching area. After this, structures for the command post are set up and very simple cover for the personnel of the subunits is prepared.

The approximate extent of work of engineer preparation of the terrain in the concentration area of a unit (battalion) and the required manpower and equipment for their fulfilment are shown in Table 1.

Table 1

	Unit of	1	Reg	uirements
Designation of work	Measure	Quantity		Bulldozer
•			Man/	Machine/
			Days	Hours
Camouflage of combat and transport equipment	_	-	100	_
Preparation of cross- country routes to exit on the main route	km	10	18	10
Construction of slit trenches for 30 to 40 percent of the personnel	item	30	45	_
Erection of blindages from prefabricated elements at the command				
post of the battalion	**	3	36	-
Preparation of trenches for self-defense	"	30	9	-
Total for a concentra- tion area (in round figures)			200	10

Table 1 shows that the work of engineer preparation of the terrain in the concentration area of a battalion can be completed in one twenty-four hour period employing 50 percent of the personnel of the battalion and one bulldozer.

Taking into account that the battalion will move to the concentration area, carrying out the march as a rule at night, it is necessary to plan so that the camouflage work for the concealment of combat and transport equipment should be completed before daybreak.

Engineer Preparation of Terrain in Siting Areas

In the siting areas of missile units, primary and alternative launching sites, a technical position, site of the meteorological post, command post, disposition area of transport and fuelling batteries (batareya) and the disposition area of servicing subunits are prepared. (Sketch 5).

Diagrams of engineer preparation of some elements of a battery in battle formation are shown in Sketches 6 to 10.

The main tasks of engineer work in the launching areas are:

-the construction of launching pads (puskovaya ploshchadka) at the primary and alternate launch sites for those missile units whose launch batteries do not possess special starting assemblies (spetsialnyy startovoy agregat);

-the construction of open structures of the dugout type that ensure covered displacement of the combat and transport equipment at the positions and in the disposition areas of the subunits of the battalions;

-the construction of structures as cover for personnel (slit-trenches, blindages, shelters) at the positions, at the command and medical points, as well as in the

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disposition areas of the subunits of the battalions;	
-the construction of open structures for the protection and self-defense of the positions and areas of disposition of the subunits of the battalions;	

-camouflage measures to conceal the positions, the disposition areas and areas of maneuver;

-the preparation of the maneuver routes in the area of deployment of battle formations of the missile artillery.

To ensure the launching of the missiles from the launching sites, prefabricated pads (sborno-razbornaya ploshchadka), which can be made from reinforced concrete or wood, are used under the launcher (puskovoy stol).

The platforms are placed on a natural or artificial base and are fastened to the ground with the help of screwed-in anchorposts (anker). On hard ground, where it is impossible to use such anchorposts, the anchoring is done by the use of logs and chains.

It takes 2.5 to 3.0 hours to erect a prefabricated pad, calculated on the use of 8 men (with a K-32 crane vehicle available).

If the launch batteries possess the special assemblies which permit them to mount in a vertical position and launch the missile, the construction of launch pads is unnecessary.

To conceal the special equipment and motor vehicle transport at the positions and in the disposition areas, dugouts (kotlovan) are dug with one or two approach ramps (apparel) (cul-de-sac or drivethrough - tupilovyy ili prokhodnyy). The size of the dugout shelters is governed by the overall dimensions of the equipment to be sheltered.

The excavation of shelters for special equipment and motor vehicle transport is carried out with organic and attached mechanical earth-moving equipment (bulldozers, excavators), as well as manually.

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	During the excavation of dugouts by bulldozers, squads of 2 or 3 men should be detailed to each bulldozer in order to collapse the earth from the sides of the excavation and to give the required steepness. The same squads should carry out the cleaning up of the berms (berma) and the layout of the parapets (brustver). When excavators are used for digging dugouts the reverse scoop (observerse leaves)	ŗ
•	reverse scoop (obratnaya lopata) is employed. After the excavator has excavated the dugout, manual clearing up of the slopes, the bottom, and the approach ramps of the shelter is required.	
	For manual excavation of the dugout, the size of the squad depends on the size and type of soil, time available for excavation, and the frontage of the work.	
	The simplest form of cover for personnel is slit trenches (shchel). These slit trenches are dug to a depth of $1\frac{1}{2}$ meters and are 5 to 6 meters long. If time and materials are available, the slit trenches are built with a roof.	•
	In order to increase the degree of cover for personner from destruction by enemy atomic weapons in the siting are light shelters and blindages (blindazh) are constructed.	l eas,
	For the construction of shelters and blindages the following can be used:	
	-construction from locally available materials (mainly timber) built by the forces and equipment of the missile artillery units themselves;	
	-construction from industrial corrugated steel sheets (for structures "KVS-U", elements "FVS") and plywood (for structures "KFU") as supplied to the Soviet Army);	
	-construction from prefabricated reinforced concrete components made at field concrete plants or at the reinforced concrete plants attached to the army (front).	
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	Besides the above-mentioned types of construction, for the building of shelters and blindages in treeless, mountainous, and sandy desert areas, paper sand bags can be used.	
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The blindages are constructed with a capacity of 6 to 8 persons. The interior, as a rule, consists of bunks built in two tiers and made from materials available locally.

Unlike the blindages, the shelters are constructed with a capacity of 20 to 25 persons and they are equipped for collective antichemical defense. In these shelters, filtered ventilation is installed using field sets FVKP-Ml, hermetically sealed partitions and doors, and in wintertime, OPP stoves. For the accommodation of personnel in the shelters, two-tiered bunks are made from materials available locally (at command posts - tables for work).

The total volume of work, the expenditure of manpower, equipment, and materials for the engineer preparation of the siting area of a battalion are shown in Table 2.

Table 2

	Manpower,	equipment,	materials	, and	l wor	k
Elements of a battalion in battle formation	Volume of earth works in cubic meters (M3)	Volume of timber in M ³	No of shelters	Number of blindages	Man-days	Machine- hours
Primary launch sites (3)	1600 2300	23.1 23.1	<u>3</u> 3	-	90 81	30 48
Alternate launch sites (3)	1200	-	<u>-</u>	-	<u>-</u> 33	22
Technical position	3000 4100	18.5 53.9	<u>-</u> 7	<u>5</u>	96 161	<u>59</u> 94
Meterological post	610 140	<u>7.7</u>	<u>1</u>	-	<u>26</u>	12 2
Command post	390 430	18.4 22.8	ଧା ର	<u>-</u> 2	44 65	<u>8</u> 9
Disposition area of the transport and fuelling batteries	1200 2000	3.7 23.1	- 3	<u>1</u>	<u>30</u> 54	33 45
Disposition area of servicing subunits	30 1550	38.7	- -	<u>-</u>	<u>5</u> 105	<u>-</u> 33
Total for a battalion (in round figures)	6800 11700	70 160	6 19	6 3	290 510	140 250

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		<u>Notes:</u>		
!			1. The numerator shows work to be carried out as first priority and the denominator represents work to be carried out as second priority.	

- 2. The sequence of work laid down in the table envisages as first priority the following:-
 - construction of shelters (ukrytiye) for vehicles and assemblies which remain at the launching sites during firing, and shelters for the missiles at the positions and in the disposition areas;
 - partial preparation of the technical position and meteorological post;
 - the construction of part of the shelters for the personnel at the command post.

All other work is carried out as second priority.

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For guarding and defending positions and disposition areas of battalion subunits against attack by the ground enemy, diversionist groups, and airborne landings, positions for self-defense are constructed. Each position is provided with trenches for fire from a standing position and are connected by communication trenches. Available local features (ditches, pits, embankments, separate buildings, etc.) are adapted for defense.

In order to conceal the composition and the direction of troop movement, to conceal their disposition areas, and to mislead the enemy as to the true intentions of our troops, it is necessary to carry out on a unified plan a number of measures of troop camouflage and operational camouflage (operativnaya maskirovka).

Troop camouflage measures are carried out continuously in all types of combat directly by the troops themselves, and represent part of the general plan of the engineer camouflage measures of the front.

Operational camouflage measures are a component and integral part of the decision to carry out an operation and are implemented by the engineer units according to the operational camouflage plan of the front.

The variety of methods of camouflage and its continuity during the operation form the main principles of operational camouflage, if they are not observed it is impossible to ensure effective surprise and to bring about enemy action in a direction advantageous to us. Achievement of surprise requires thoroughly worked out camouflage measures which actively and continuously mislead the enemy.

To such measures, first of all, should be added the creation of dummy (lozhnyy) disposition areas of missile elements in combat formation, feint actions (demonstrativnoye deystviye), disinformation, and all kinds of engineer camouflage work.

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	The camouflage measures for creating dummy disposition areas of missile artillery, which are carried out on an extensive scale by the engineer units of the front, not only mislead the enemy but considerably lower the effectiveness of the use of his weapons of destruction, and compel him to deliver atomic strikes on dummy objectives.	
	Under modern conditions, with the thorough concealment of the actual disposition areas of the troops, it is necessary to display the dummy areas at a sufficient distance away from the actual areas so as to ensure the safety of the latter if the enemy carries out an atomic strike.	
	In this respect, the plan for operational camouflage of the front must define the sequence, place, and time limits for carrying out the engineer camouflage measures, based on the grouping of the troops and the time limits for carrying out the operation as a whole.	
	Correctly planned camouflage measures to conceal the true objectives and to display to the enemy the dummy objectives can assist in conserving our material and morale forces and also decrease losses from the enemy use of weapons of mass destruction.	
	In the dummy areas, the billeting and activity of troops are simulated.	
	The simulation of missile equipment in the dummy areas is achieved by the setting up (ustanovka) of high-quality prefabricated dummies (sborno-razbornyy maket), of the most typical types of equipment (launching assembly with missile, cross-country carriers - gruntovaya telezhka, saddle crane - sedelnyy kran, and others). The dummies must be industrially produced and be delivered by the front in a centralized manner. During the simulation of occupation of dummy areas by subunits of the missile artillery, means of transport are assigned (unemployed cross-country carriers or ordinary trucks with semi-trailers	
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	equipped with camouflage frameworks) which carry out traffic movement in the dummy areas and on the roads leading to them.	
	The quantity of dummy equipment and the dummy engineer structures for it must be up to 50 percent of the organic battle equipment of the subunits represented. For dummy launching assemblies with missiles the norms must be not less than 100 percent.	
	In the areas displaying dummy launching sites, checking-out points, fuelling, and other elements of combat formation, reliable shelters will have to be built for the personnel of the subunits detailed to carry out the simulation.	
	Artificial scarring (raspyatneniye) of the ground in conjunction with the dummy shelters adds to the completeness of the engineer preparation of dummy disposition are of missile artillery.	as
	This scarring of the terrain is carried out by means of removing the topsoil with a bulldozer, grader, or other excavating vehicles. The patches that are formed must correspond with the patches that are created as a result of moving the spoil (otsypka) and leveling it out after it is taken from the dugouts during the construction of real shelters. The size of these patches should be 600 to 700 m ² for normal equipment and 800 to 1,000 m ² for equipment of large dimensions.	a ′
	During the display of dummy objectives and simulated actions of missile equipment, one must always keep in minor the possibility of enemy radar surveillance. By an intelligence use of suitable means during the display of dummy objectives, the enemy can be misled.	l
	For this it is most advisable to use corner reflectors (ugolkovaya otrazhatel). Calculations show that when simulating a launching site it is necessary to use approxily up to 30 of these reflectors of various types (KT4-100 3 reflectors, K1-100 - 12 reflectors, K8-600 - 15 reflectors	.mate-
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The camouflage of missile units. The object of camouflaging missile units is to ensure the concealment of their actions and disposition areas from all modern means of optical, radar, and aerial reconnaissance of the enemy.

The engineer preparation of the terrain must begin with the camouflage measures and end with them. Here it should be taken into consideration that ill-timed and tardy camouflage is not only useless, but even harmful.

The main camouflage tasks for the siting areas are:

- -the concealment of the elements of units in combat formation at the siting areas;
- -the concealment of combat and transport equipment and engineer structures;
- -the concealment of the movement of transport and fuelling batteries from the disposition areas to the launching sites and back again.

The concealment of the elements of units in battle formation in the siting areas is achieved by: making use of natural camouflage (concealment features and configuration of the terrain, conditions of limited visibility); by combining siting areas with defense zones and concentration areas, previously equipped but not occupied by combined-arms units (large units), and in certain cases with dummy areas, identified (as dummy ones) by the enemy, by constructing alternate positions.

As means of natural camouflage, one can make use of forests, groves, gardens, inhabited localities, and unevenness of the terrain (gullies, hills, and various folds of the ground).

Approximate requirements for natural camouflage for concealed and dispersed disposition of elements of a combat formation of a battalion in a siting area are shown in Table 3.

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Table 3

Designation of elements of a battalion in battle order	Number of units of calculation*	Forest area in hectares	No. of house- holds in a rural inhab- ited locality	The length of gullies in kilometers
Launching site (one)	16	1.2	8	0.3
Technical position	100	, 8	50	2
Disposition area of the transport & fueling batteries	150	12	75	2.5
Battalion Command Post	9	0.7	5	0.2
Meteorological Post	8	0. 6	4	0.15
Total for a battalion (in round numbers)		25	140	6

*A unit of calculation (raschetnayayedinitsa) for equipment is considered to be an artillery prime mover, troop transport, or special vehicle. Equipment of large dimensions (cross-country carrier or ground carriage with a prime mover, and others) is correspondingly equal to three to four units of calculation.

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	With the absence or shortage of natural camouflage and the necessity for the disposition of troops in open ground, the camouflage of missile units in combat formation becomes much more difficult and assumes paramount importance. The most acceptable decision in such a case is the movement (razmeshcheniye) of the elements of the units in combat formation to prepared positions not occupied by combined-arms units or large units (Sketch 11). With such a disposition it is advisable to combine the shelters for the equipment with the trenches and group shelters that have been dug but not occupied by tanks and artillery, and they should be included in the system of trenches and communication trenches.
	In a terrain previously prepared, but not occupied by the troops, the shelters and the whole system of trenches and communication trenches built by them represent not only defensive works but also camouflage which permits the concealment of subunits with their equipment from enemy optical, radar, ground, and aerial surveillance.
	The concealment of the engineer structures and combat equipment deployed in shelters and outside them is achieved through the use of technical methods of camouflage (the employment of artificial camouflage, laying smokescreens, camouflage paint, etc.).
	For technical methods of camouflage the following are used:
-	-organic means (camouflage sets - komplekt masok);
	<pre>-expendable resources and materials (camouflage coverings, camouflage paper, smoke means and others);</pre>
	-locally available materials are widely used by the troops in all situations (poles, brushwood, etc.).
4 - S	Sketches 12 to 19 show the most typical technical methods of camouflaging missiles, special equipment, and shelters with special equipment at the sites and in the disposition areas.
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	The concealment of the shift of missile units can be attained by organizing the move under conditions of limited visibility (night, rain, fog). The transport routes must be chosen in concealed and uninhabited area	
	To lessen the conspicuousness of the characteristic exterior shape of missiles moving on the cross-country carriers, tank trucks, and other combat equipment, it i essential to use decorative camouflage frames (karkas) covered with canvas or with camouflage netting MPT-4; at the same time the covering must have a coloring that breaks up the outline. It is necessary to erect on the frames half-dummies (polumaket) of normal equipment. For example, a cross-country carrier with a missile on a trailer drawn by a prime mover can be camouflaged as a motor convoy (avtopoyezd) (Sketch 20) or as a load of long lumber (Sketch 21).	s
	In order to use this camouflage method more success: it is essential, in each individual case, to determine the most suitable object for disguising this or that velkeeping to the principle of varying the camouflage.	
	The antiradar camouflage of the missile units in combat formation at their siting areas must be directed against the detection of the latter, mainly by the airborne radar stations of the enemy. This is attained	by:
1.	-making use of the camouflage properties of the terra i.e., the disposition of objectives in the dead zone (v zone poley nevidimosti) created by the unevenness of the ground, by local features, and other natural camoufl	
	-the disposition of combat equipment in trenches and shelters;	
	-the setting up of artificial antiradar camouflage material (camouflage screens and interference camouflage mask-ekran i mask-pomekh);	· - .
,	-the use of special radiotechnical equipment for crea jamming of the enemy radar stations.	ting
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The requirement of personnel and equipment for carrying out the camouflage measures in the siting areas depends on the condition of the situation and terrain and can fluctuate widely.

Preparation of roads and cross-country routes is one of the most important conditions for ensuring the uninterrupted combat activity of missile units.

The presence in these units of heavy equipment (materialnaya chast) of large dimensions levies greater demands on roads and cross-country routes.

The main technical demands levied on roads and cross-country routes are shown in Table 4.

Table 4

Basic indices	Quantity
Width of the roadway (minimum) in meters:	
- for two-way traffic	7.0
- for one-way traffic	3.5
Minimum turning radius in meters	15.0
Longitudinal slope of the roadway (maximum) in degrees	10-15 ⁰
Camber in degrees:	
- of roadway	10-150
- on bends (maximum)	80
Load capacity of bridges and various road structures in tons	40.0
Bridge clearance (minimum) in meters	4.0
Minimum permissible pressure on the road- bed, in kg/cm ²	0.8

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·	The total extent of roads in the siting area of a missile artillery battalion consists of 30 to 40 kilome (from the technical position to each of the launch site the distance is from 5 to 8 kilometers, inside the technical position up to 8 kilometers, and from the disposition area of the transport and fuelling batteries to the technical position, 4 to 6 kilometers).	es ·
	The engineer preparation of movement routes include the reconnaissance of the existing roads and paths of cross-country routes, restoration and repair of existin roads, and the construction of cross-country routes.	•
	In the preparation of the routes it is essential to make maximum use of the existing road network. The building of new roads coming to a dead end at the sites is inadmissible from the point of view of camouflage of the positions. The necessary volume of road work in the launching areas is determined by the availability o existing roads, their number and condition, the possibi of moving cross-country without roads, as well as the capabilities of the missile artillery units for the preparation of roads.	f
	The presence of existing roads, their condition, as well as the possibilities of moving cross-country without roads, depend mainly on the theater of operatio and on the destruction existing there.	ns
	The capabilities of a battalion in the preparation of routes are determined on the basis of the personnel and equipment which the battery can employ for engineer preparation of movement routes. Approximate increased work norms for the construction of movement routes are shown in Table 5.	
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Table 5

	Time norms	Required personnel
Designation of work	in hours	and equipment
Laying of 1 km of cross- country route for one-way traffic		
- on average broken (sredneperesechennyy) terrain	0.7 to 1.2	Platoon, crane vehicle, bulldozer (BAT), mine detectors
- in a forest area	3 to 5	Platoon, crane vehicle, bulldozer (BAT), mine detectors
- in a mountainous area	10 tó 15	Company (rota), bull- dozer (buldozer - BAT), explosives - 70 to 100 kg, mine detectors
Restoration and repair of 1 km of existing road (for the width of one-way traffic)	1.2 to 2	Bulldozer, motor-grader, a section of soldiers, mine detectors

 $\frac{\text{Note:}}{\text{rest}}$ During the laying of cross-country routes and the $\frac{\text{rest}}{\text{rest}}$ rotation and repair of roads, it is compulsory to check them for the presence of mines.

With the presence of a combat-engineer platoon, a missile artillery battalion will be able to carry out only minor work with its manpower on the improvement of approach roads leading to the sites.

The engineer preparation of the main routes in the siting areas and particularly of the movement routes during the battle (operation), as a rule is carried out by the engineer units of the army (front) or by the road-engineer subunits attached to the missile units (large units).

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The total volume of work and the expenditure of personnel and equipment for engineer preparation of a battalion siting area are given in Table 6.

Table 6

	The volume of excavations in			Manpower & equipment requirement					nents	
	•	ic met		Ma	Man-days			Machine-hours		
Designation of work	1st Priority	2nd Priority	Total	1st Priority	2nd Priority	Total	1st Priority	2nd Priority	Total	Lumber in m ³
Checking the terrain for mines	-	-	-	50	-	50	-	-	_	-
Engineer preparations of the terrain	6800	11700	18500	290	510	800	140	250	390	235
Camouflage measures	-	-	-	76	50	126	8 -	3	11;	15
Preparation of roads and cross-country routes	-	-	-	100	-	100	20	-	20	10
Preparation of water supply points	-	-	-	-	4 <u>0</u>	40	-	-	-	4
Total for siting area (in round figures)	6800	11700	18500	510	560	1070	170	250	420	260

Note: The checking of the terrain for mines is carried out by the attached combat engineer subunits and does not enter into the total volume of engineer preparation.

From Table 6, it follows that the most labor-consuming part of the engineer preparation at siting areas is the earth-moving operations (up to 19,000m³ of soil).

When 60 to 70 percent of the personnel and organic mechanical equipment are employed to carry out the full volume of engineer preparation of the battalion siting area, a considerable amount of time will be required (up to 8 days). This amount of time, however, cannot be allowed in practice. Therefore, in order to reduce the time for the engineer preparation of a siting area, missile units should be supplied with additional earth-moving equipment (bulldozers, excavators), and in cases when roads are in an unsatisfactory condition, with a bulldozer (puteprokladchik) BAT. It is advisable to make use of attachable bulldozer equipment for the prime movers AT-T and AT-S.

By reinforcing the battalion with 4 to 5 bulldozers (or with 4 to 5 sets of attachable bulldozer equipment for the prime movers AT-T and AT-S), the first priority engineer preparation at the siting area can be completed within two 24-hour periods, and the second priority preparation within three 24-hour periods (see Table 2). Besides, all the main earth-moving operations will be completed with the aid of mechanized equipment.

Special Features of Engineer Preparation in Mountainous Terrain

The nature of engineer preparation of positions in mountainous terrain is determined by the special features of mountain conditions, of which the principal are:

-limited number of roads;

-difficulties in getting bulky equipment through the existing mountain roads;

-a sharply broken terrain, which helps in the camouflaging of the disposition of the missile units, but at the same time makes the choice of combat positions more difficult;

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-the widespread prevalence of stony and rocky soil which requires loosening and blasting operations, making the use of mechanical earth-moving equipment difficult.

The above-mentioned special features hamper engineer preparation in concentration areas and siting areas, the preparation of a road network, and to a great extent increase the expenditure of labor for engineer preparation of the terrain.

To ensure the moving out of units from concentration areas (disposition areas) to siting areas, routes are prepared in good time, one for each battalion. When it is impossible to provide one route for each battalion, a large unit of missile units is allotted 1 or 2 routes, or they are prepared, but when approaching the siting area, 5 to 10 km from it the routes must branch, providing one route per battalion. In order to conceal the places of disposition of the siting areas from enemy aerial reconnaissance, the routes for movement of the battalions to these areas must not be constructed from the same point as the large unit route.

In the siting area one through route and approach routes to the separate elements of the battalion in combat formation are prepared.

In order to reduce the volume of work of preparing the routes and approach routes in mountain conditions, it is essential to make the maximum use of existing roads, preparing them for transit by missile equipment, the crosscountry routes should be laid in the sectors of the terrain with the minimum amount of work, and sectors with rocky and other hard ground where mechanical equipment cannot be used should be bypassed if possible.

The routes are prepared by the personnel of the traffic control detachments (otryad obespecheniya dvizheniya - OOD). The composition of these detachments depends on the specific volume of the road and bridge work, which is determined during the engineer reconnaissance of the route, and can include 1 to 2 combat-engineer platoons with motor vehicle transport, a road-layer BAT (or bulldozer), explosives (100 to 200 kg), road signs, and materials for bridge and other road structures.

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	In order to increase the traffic capacity of the mountain roads, and to ensure the safe movement of he and bulky equipment, it is necessary:	avy					
	-to construct the roadbed so that it is banked on the side away from the mountain so that it slopes 2 t 2.5 percent toward the mountain;	•					
	-to increase the radii of the curves at sharp bend of the roads;	s					
	-to erect guardrails (ograzhdeniye) on all steep s at the outer edge (brovka) of the road - wooden or me rail posts, barriers made from separate rocks, etc.;	lopes tal					
	-at steep ascents, descents, and bends of the road have available stocks of materials (sand, crushed rockensure normal movement in rainy weather and icy period	k) to					
	-at the sectors most dangerous for traffic (long gracipices, etc.) to install mechanical equipment (provers, winches) in order to give assistance to passing equipment;	ime					
	-to equip the routes with road signs and indicators for day and night traffic;	5					
	-to maintain an average speed in mountains of up to 10 to 12 kph in daytime, 4 to 6 kph at night, and $1\frac{1}{2}$ to 2 kph in mountain pass areas.	to					
	For the concealment of combat and transport equipment the concentration areas and siting areas, maximum ushould be made of the locally available camouflage capand natural cover.	ise					
	The erection of engineer structures as shelters for personnel, combat and transport equipment in rocky and other ground difficult to work in must be kept to the minimum necessary.						
	In a mountainous area, the bulldozer equipment for moving operations with prime movers should be used fir all with the AT-T prime mover.	earth- est of					
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Depending on the nature of the ground, the engineer structures for shelter of personnel and equipment can be of the dugout, half-buried and earthwork type of construction.

The dugout structures (kotlovannyy) are, as a rule, constructed in places where it is possible to excavate with earth-digging machines or manually to a depth of not less than $1\frac{1}{2}$ to 2 meters.

The half-buried (poluzaglubennyy) types of structures are made by digging dugouts to a depth of 90 to 100 cm. In this case the structures are made with raised parapets (revetments - obsypka).

The earthwork type (nasypnyy tip) of structure is constructed when the layer of topsoil is shallow (20 to 50 cm) and has a rocky base. In this case the rock is not worked on, but high embanked parapets (revetments) are built of stones, earth-filled fascines, sandbags, etc.

For the construction of dugouts in rocky ground, explosives and compressors with pneumatic tools (pnevmoinstrument) or electric drills (elektroperforator) should be used to the maximum possible extent.

When using explosives in the construction of dugouts, the following approximate expenditure of explosives for one cubic meter of excavated ground will be required;

- -on hard and stony ground 1.5 to 1.9 kg;
- -on rocky ground 2 to 2.6 kg

The dugouts for shelters and blindages are constructed in rocky ground by using a single or several, buried, concentrated charges. For example, the construction of a dugout for a light type of shelter using a single concentrated charge is shown in Sketch 22.

Dugouts for the sheltering of equipment are constructed by using several concentrated charges. The number of charges used and the distances between them depend on the dimensions

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of the shelter to be constructed, and the size of the charges depends on the type of soil. By placing the charges at a depth of 90 to 110 cm, a hole with a depth of 1 to 1.4 meters is formed.

After the explosion the holes are finished off manually and raised parapets are built. The approach ramps are made by using additional explosive charges, equal to half the normal charge, and placed in boreholes (kilodets) at a depth of 45 to 55 cm.

For example, to make a hole for a shelter for a cross-country carrier with a missile and a prime mover, it will be necessary to use 12 charges of 25 to 35 kg each and 2 charges of 10 to 15 kg each (the distances between the charges - 180 cm, the depth at which they are placed - 110 cm).

The camouflage of combat formations in mountainous conditions is carried out according to the methods described above. Taking into account the large amount of soil scattered during the construction of shelters by the explosives method, in mountainous conditions more extensive use of artificial scarring of the terrain for camouflage must be employed.

Special Features of Engineer Preparation Under Winter Conditions

In principle the nature of engineer preparation for missile units under winter conditions does not differ from engineer preparation under normal conditions.

In winter, engineer preparation requires greater expenditure of manpower and equipment than in normal conditions; in connection with this, it is essential, for the protection of personnel and equipment, to make use, first of all, of natural cover. The construction of earthworks when there is a deep layer of frozen soil should be kept to the minimum necessary.

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Special features of winter conditions mainly influence the construction of earthworks, construction and maintenance of roads and cross-country routes and also camouflage of certain types of equipment and combat formations.

Shelters and blindages for personnel are constructed during winter in the same way as under normal conditions.

With snow of an insignificant depth, shelters for equipment are excavated in the ground and the snow used as camouflage. When the depth of snow is significant (80 cm or more) it is possible to construct shelters in the snow with parapets made from packed snow, also shelters dug partly in the snow and partly in the ground.

In certain cases individual dugout shelters can be constructed with a covering to assist camouflage and as a protection from drifting snow.

The pits for the shelters, blindages and cover for equipment can be made by the use of explosives to blow out the soil with subsequent working of the slopes and the bottom of the pit, and also for breaking up the top frozen layer of soil for subsequent excavation of the pit with earth-moving equipment or manually.

The breaking-up of frozen ground can be carried out with explosives or with pneumatic and entrenching tools.

For mechanized work on frozen ground, hammer drills (burilnyy molotok) RP-17 or RPM-17 and pneumatic drills (otboynyy molotok) OMSP-5 are employed, run by a compressor.

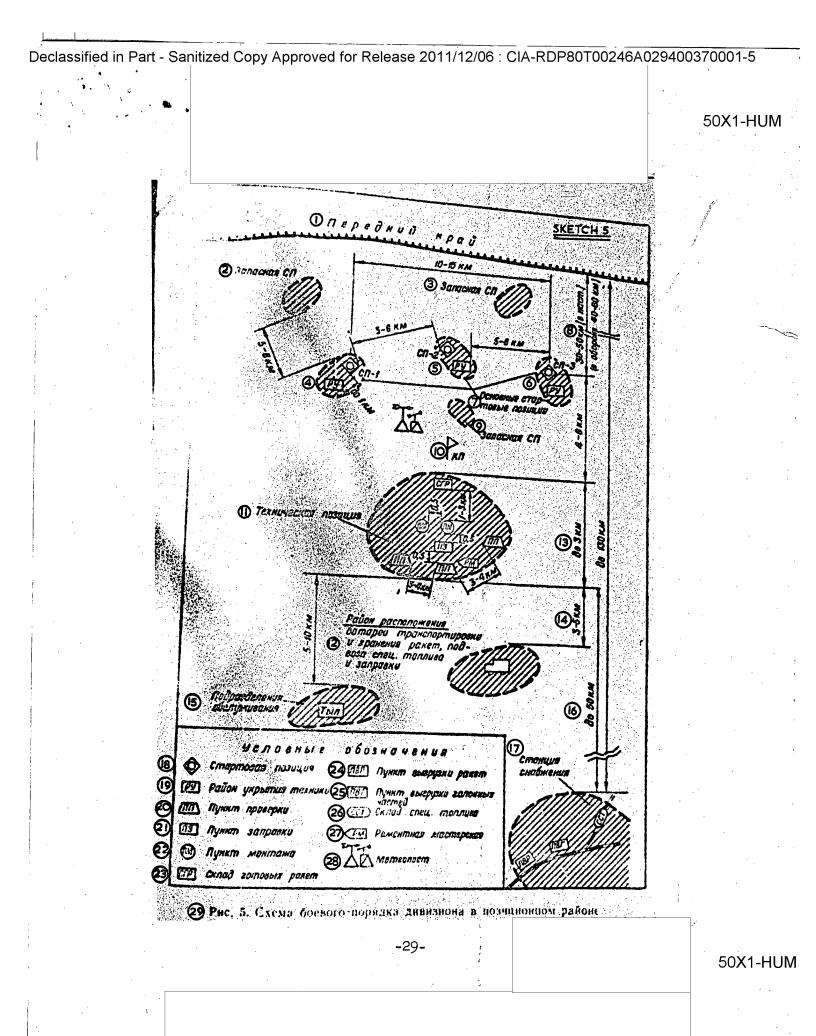
Winter roads and cross-country routes are laid cross-country, over frozen swamps, rivers, and lakes. The existing roads are widely utilized and are prepared for use in winter conditions.

During the construction (maintenance) of winter roads and cross-country routes, the main type of work will be the clearing of snow from the route. This clearing of the route is carried out with special snow-clearing machinery: tank snowplows STU, bulldozer BAT, tractor snowplows D-180B, as well as bulldozers and motor-graders.

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In the absence of commercially made mechanical equipment, the clearing of snow from the routes is carried out by the simplest means, which are constructed in the units (single and double - V blade) snowplows, snow clearers (valorazbrasyvatel), and ice-chippers (idoskalyvatel), and others, and also manually. In preparing a cross-country route, across ground covered with snow, for the use of a small number of vehicles, tanks and tractors can be utilized (for packing the snow on the route). When preparing a cross-country route with a more even packing of snow on the snow-covered countryside, vehicles with a harrow, graders, and smooth rollers are run over it. To camouflage combat and transport equipment, as well as its disposition areas, in open and flat terrain covered with snow, sets of winter camouflage materials are used as well as the painting of combat and transport equipment white. In winter conditions, snow should be used widely as a locally available material for camouflaging equipment and structures. It would be advisable to verify the principles of engineer preparation of missile unit positions presented in this article during exercises and the practical training of these units.	· a \	Part - Sanitized Copy Approved for Release 2011/12/06 : CIA-RDP80T00246A029400370001-	-5
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SKETCH 5

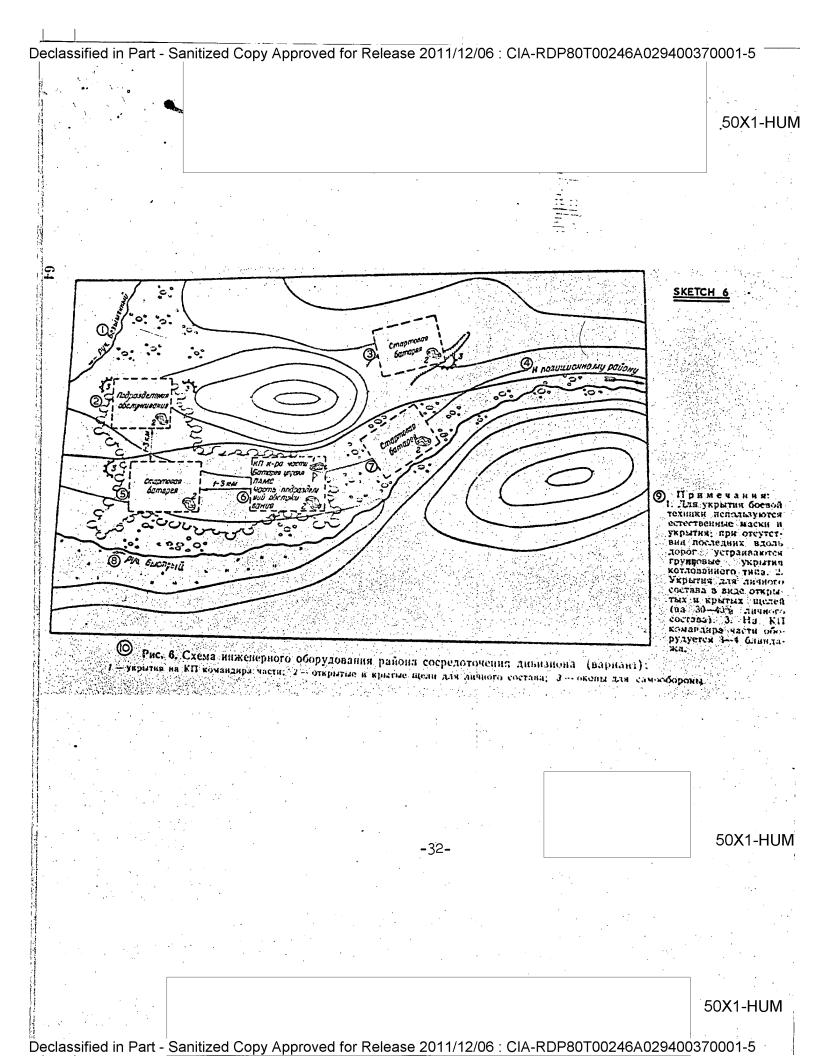
DIAGRAM OF A BATTALION IN COMBAT FORMATION AT THE SITING AREA

- (1) Main line of resistance
- (2) Alternate launch site
- (3) Alternate launch site
- (4) Primary launch site 1 (up to 1 km)
- (5) Primary launch site 2
- (6) Primary launch site 3
- (7) Primary launch sites
- (8) 30-50 km (in an offensive) (in defense 40-80 km)
- (9) Alternate launch site
- (10) Command post
- (11) Technical position
- (12) Disposition area of the transport and storage of missiles, delivery of special fuel, and fuelling batteries
- (13) up to 3 km up to 130 km
- (14) 3-5 km
- (15) Servicing subunits Rear
- (16) up to 50 km
- (17) Supply railhead
- (18) Launch site (startovaya positsiya)

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- (19) Area of cover for equipment (rayon ukrytiya tekhniki)
- (20) Checkout point (punkt proverki)
- (21) Fuelling point (punkt zapravki)
- (22) Assembly point (punkt montazha)
- (23) Storage depot of ready missiles (sklad gotovykh raket)
- (24) Missile unloading point (punkt vygruzki raket)
- (25) Nose cone unloading point (punkt vygruzki golovnykh chastey)
- (26) Special fuel dump (sklad spets. topliva)
- (27) Repair workshop (remontnaya masterskaya)
- (28) Meteorological post (meteopost)
- (29) Sketch 5. A diagram of a battalion in battle formation at the siting area



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SKETCH 6

DIAGRAM OF THE ENGINEER PREPARATION OF THE CONCENTRATION AREA OF A BATTALION

- (1) Unnamed stream
- (2) Servicing subunits
- (3) Launch battery
- (4) To siting area
- (5) Launch battery
- (6) Command post of the commander of the unit. HQ battery. Mobile artillery meteorological station. Part of the servicing subunits
- (7) Launch battery
- (8) Fast-flowing stream
- (9) Notes: 1. For concealment of combat equipment natural camouflage and shelters are used: in their absence group shelters of dugout type are constructed along the roads.
 - 2. Cover for personnel in the form of open and covered slit-trenches (for 30 to 40 percent of the personnel)
 - 3. At the Command Post of the commander of the unit, 3 or 4 blindages are provided.
- (10) Sketch 6. Sketch of Engineer Preparation of the concentration area of a battalion (Example):
 - 1. Shelters at the command post of the commander of the unit;
 - 2. Open and covered slit-trenches for personnel;
 - 3. Trenches for self-defense.

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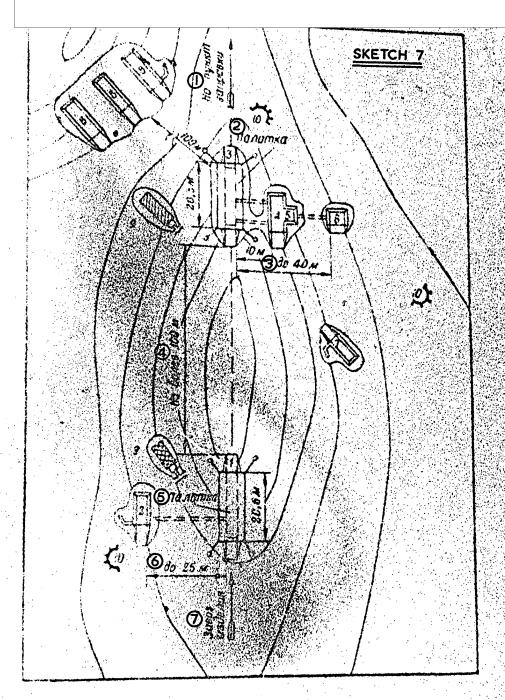


Рис. 7. Скема инжето посто оборудования пункта проверки на

В 1— укрытие для инквионения най раксты; 7— укрытие для компрессорьной маналова. 7— укрытие для масктроиспытаций раксты; 4— укрытие для маналова по для и питательной маналов; 5— укрытие для электропресита; 7— укрытие для бельного игрентов; 6— укрытие для бельного игрентов; 6— укрытие для бельного за региза; 6— укрытие для бельного маналова ЗПЛ, 8— укрытие для борговах маналов для самоофопил.

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SKETCH 7

POINT AT THE TECHNICAL POSITION

- (1) To fueling point
- (2) Tent
- (3) Up to 40 m
- (4) Not more than 100 m
- (5) Tent
- (6) Up to 25 m
- (7) Delivery of missiles (izdeliye)
- (8) Sketch 7. Diagram of engineer preparation of a checking point at the technical position.
 - 1. Shelter for pneumatic testing of the missile
 - 2. Shelter for compressors;
 - 3. Shelter for electrical testing of the missile;
 - 4. Shelter for testing equipment;
 - 5. Shelter for the electro-converter assembly (elektropreobrazovatelnyy agregat);
 - 6. Shelter for the gasoline engine generator;
 - 7. Shelter for the ZIL vehicle;
 - 8. Shelter for open trucks (bortovaya mashina);
 - Shelter for personnel;
 - 10. Trenches for self-defense.

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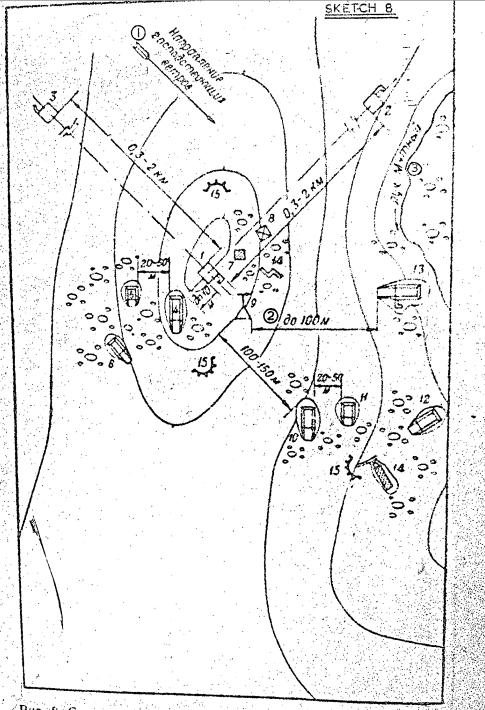
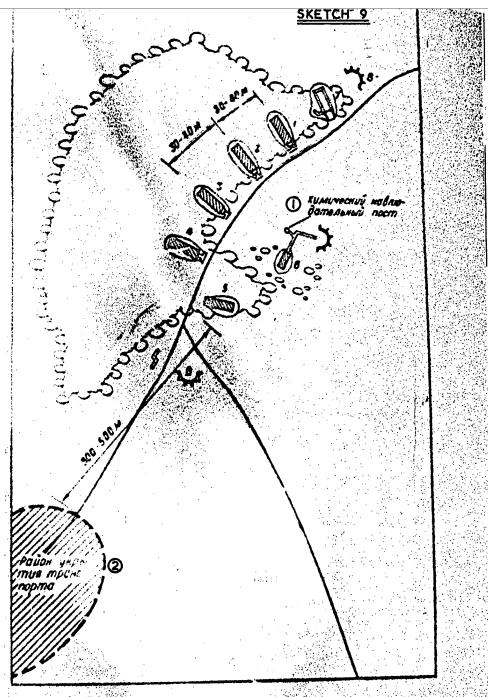


Рис. 8. Схема инженерного оборудовання позиции метеопоста: 1— первый теодолитный пункт основной шаропилатной базы; 2— вриждой теодолитный пункт основной шаропилетной базы; 3— теоделитный станции РМС-1; 5— укрытие для засктроагрегата; 6— укрытие для надологовационной АТ-С; 7— булка для выдержки разполондов; 8— палатах для для недержки разполондов; 8— палатах для двигорализма машаны ПАМС-11— укрытие для какспрацией 10— укрытие для укрытие для для для двигоратрегата; 11— укрытие для какспрацией 12— укрытие для для двигоратрегата; 14— укрытие для какспрацией 14— укрытие для какспрацией 14— укрытие для станового подин

SKETCH 8

DIAGRAM OF ENGINEER PREPARATION OF A METEOROLOGICAL POST

- (1) Direction of prevailing winds
- (2) Up to 100 m
- (3) "Muddy" stream
- (4) Sketch 8. Diagram of engineer preparation of a meteorological post.
 - 1. The first theodolite point of the main pilot balloon base;
 - 2. The second theodolite point of the main pilot balloon base;
 - 3. Theodolite point of the alternate pilot balloon base;
 - 4. Shelter for radar station RMS-1:
 - 5. Shelter for the electrical asssembly;
 - 6. Shelter for AT-S;
 - 7. Shack for housing radiosondes;
 - 8. Tent for filling pilot balloons;
 - 9. Ground observation point;
 - 10. Shelter for the vehicle with apparatus of the field artillery meteorological station (PAMS);
 - 11. Shelter for the electrical assembly;
 - 12. Shelter for AT-S;
 - 13. Shelter for the gas-generating station;
 - 14. Shelter for personnel;
 - 15. Trenches for self-defense.



Э Рис. 9. Схема инженерного оборудования командного цункта дивизиона:

1 — укрыме для командари части и ого заместителой: 2 — укрыпае для инчиого состава иностационной за укрыпае для инчиого состава подразаделений связи; 5 — укрыпае для сидений подготокий данных подразаделений связаделений за укрыпае для развединию за укрыпае для развединию за связообороны ини Р-ПЗ; 6 — околы для связообороны

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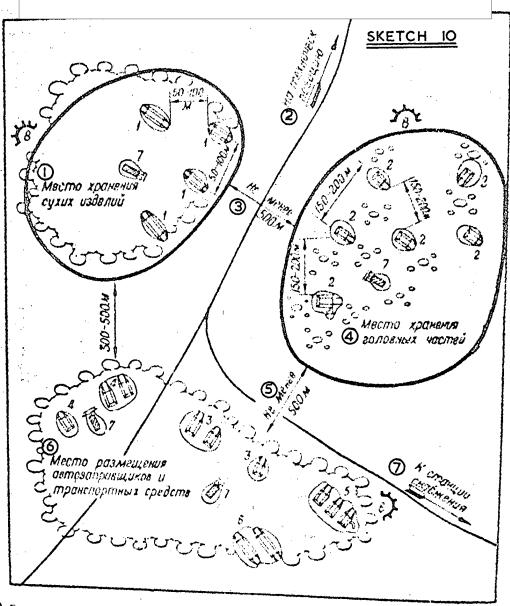
SKETCH 9

OF A BATTALION COMMAND POST

- (1) Chemical observation post
- (2) Shelter area for transport
- (3) Sketch 9. Diagram of the engineer preparation of a battalion command post.
 - Shelter for the unit commander and his deputies;
 - 2. Shelter for the staff;
 - 3. Shelter for the signal center;
 - 4. Shelter for the signals subunit personnel;
 - 5. Shelter for the data-computing section;
 - 6. Shelter for reconnaissance and chemical personnel;
 - 7. Shelter for radio station R-103;
 - 8. Trenches for self-defense.

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В Рис. 10. Скема инженерного обору дондния района расположения батарси транспортировки и заправки:

контейнеров с головизми частими (до 10 шт.); 2— укрытия для правинера окислителя (до 12 шт.); 4— укрытия для автозатороваето (до 4 шт.); 5— укрытия для автозатороваето (до 4 шт.); 5— укрытия для бартовых машии (до 12 шт.); 6— укрытия для оборовых машии (до 12 шт.); 6— укрытия для груптовых головек (до 12 шт.); 7— укрытия для лич-

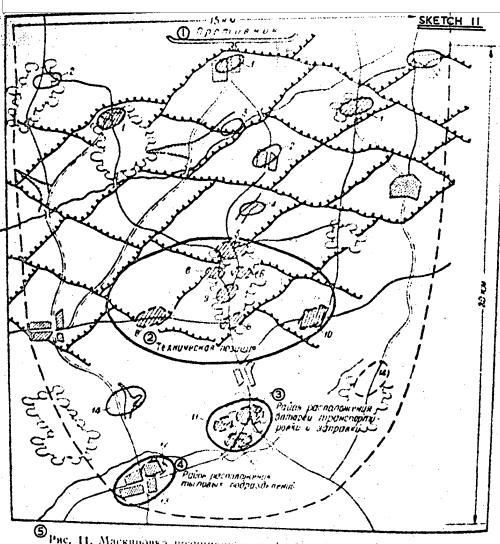
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SKETCH 10

DIAGRAM OF ENGINEER PREPARATION IN THE DISPOSITION AREA OF A TRANSPORT AND FUELING BATTERY

- (1) Storage area for dry missiles
- (2) To the technical position
- (3) Not less than 500 m
- (4) Storage area for nose cones
- (5) Not less than 500 m
- (6) Disposition area of the fueling vehicles and means of transport.
- (7) To the railhead
- (8) Sketch 10. Diagram of engineer preparation in the disposition area of a transport and fueling battery
 - 1. Shelter for containers with missiles (up to 10);
 - 2. Shelter for containers with nose cones (up to 30);
 - Shelter for oxidizer delivery vehicles (up to 12);
 - 4. Shelter for fuel delivery vehicles (up to 4);
 - 5. Shelter for open (bortovoy) trucks (up to 12);
 - 6. Shelter for cross-country carriers (up to 12);
 - 7. Shelter for personnel (4);
 - 8. Trenches for self-defense





Брис. 11. Маскировка позиционного разона динизиона (вариант):

1— основная старговая позиция; 2— запасног стартовая позиция; 3— позиция метеоствиция;

4— КП динизиона; 5— склад готовых ракет технической позиции; 6— пункт монтажа;

7— пункт заправки; 8— пункт проверки; 9— место хранения сухих ракет, 10— место храпения годовных частей; 11— район укрытая транепортных средств; 12— авторемонтияя мастерская; 13— склад ГСМ; 14— район искусственного распятнения местности.

Примечвине. Пунктиром показано движение грунтовых тележек состартовых позиций после их разгрузки;

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SKETCH 11

CAMOUFLAGE OF A BATTALION SITING AREA (VARIANT)

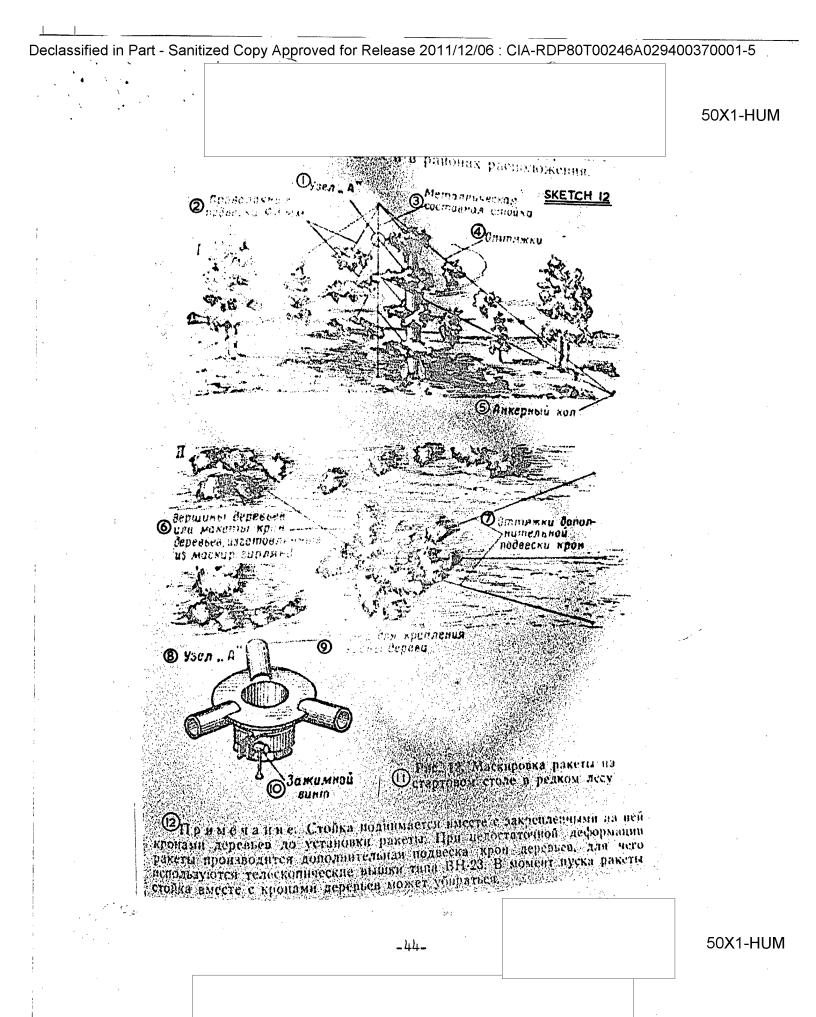
- (1) Enemy
- (2) Technical position
- (3) Disposition area of the transport and fueling battery
- (4) Disposition area of rear subunits
- (5) Sketch 11. Camouflage of a battalion siting area (variant):

-1/-t, .

- 1. Primary launch site;
- 2. Alternate launch site:
- 3. Position of the meteorological station;
- 4. Battalion command post;
- 5. Technical position storage depot for ready missiles:
- Missile assembly point (punkt montazha);
- 7. Fueling point;
- 8. Checkout point;
- 9. Storage place for dry missiles;
- 10. Storage place for nose cones;
- 11. Shelter area for transport means;
- 12. Motor vehicle repair shop:
- 13. POL dump;
- 14. Area of artificial scarring of the ground.

Note: The dotted line shows the movement of the crosscountry carriers from the launch sites after unloading.

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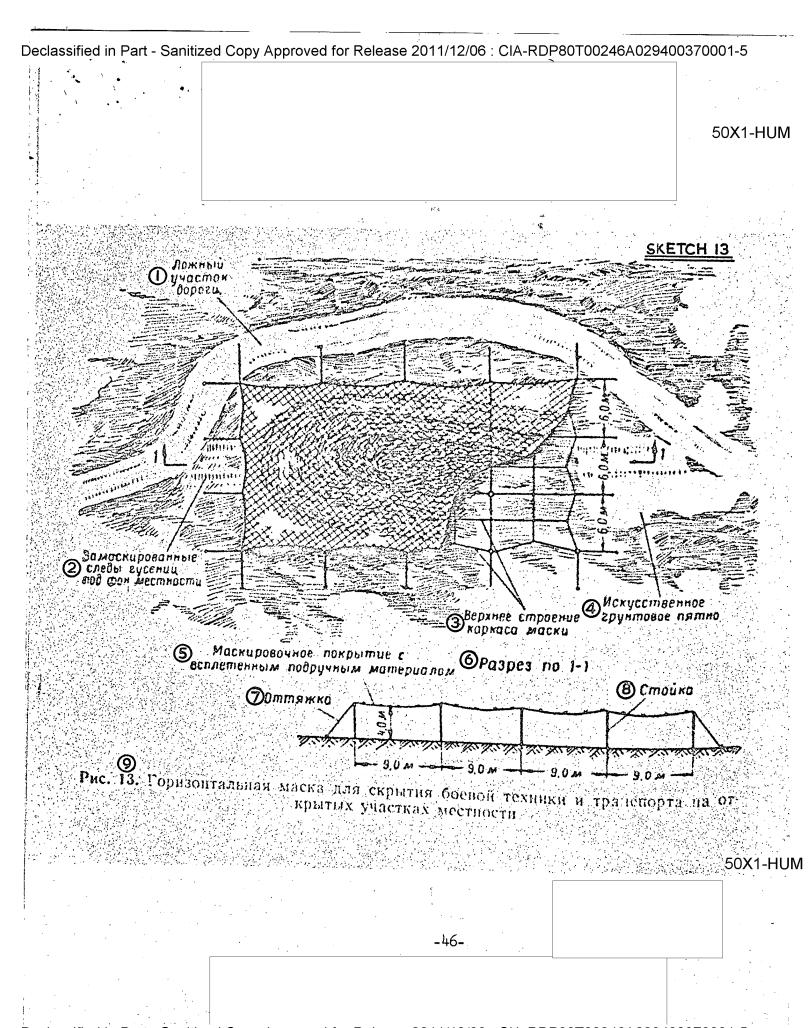


SKETCH 12

THE CAMOUFLAGING OF A MISSILE ON A LAUNCH PLATFORM IN A SPARSE FOREST

- (1) Mounting (uze1) "A"
- (2) Suspension cables of 3 mm diameter
- (3) Metal sectional mast
- (4) Guy lines
- (5) Anchoring stake
- (6) Tops of trees or mock-up of crowns of trees made from camouflage garlands.
- (7) Guy cables for the additional suspension of crowns
- (8) Mounting "A"
- (9) Sleeve for bracing mockup tree crowns
- (10) Clamping screw
- (11) Sketch 12. The camouflaging of a missile on a launcher in a sparse forest
- (12) Note: The mast is erected with the tree crowns already fixed in position before setting up the missile. If the missile is insufficiently disguised, an additional suspension of tree crowns is made using telescopic masts type VN-23. At the time of launching the missile, the mast with its tree crowns can be removed.

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SKETCH 13

HORIZONTAL CAMOUFLAGE NET FOR THE CONCEALMENT OF COMBAT EQUIPMENT AND TRANSPORT IN OPEN SECTORS OF THE TERRAIN

- (1) Dummy section of road
- (2) Caterpillar tracks camouflaged as the terrain background
- (3) Upper structure of the framework of the camouflage
- (4) Artificial ground scar
- (5) Camouflage covering of interlaced locally available materials
- (6) Cross-section between points numbered 1
- (7) Guy line
- (8) Mast
- (9) Sketch 13. Horizontal camouflage net for the concealment of combat equipment and transport in open sectors of the terrain

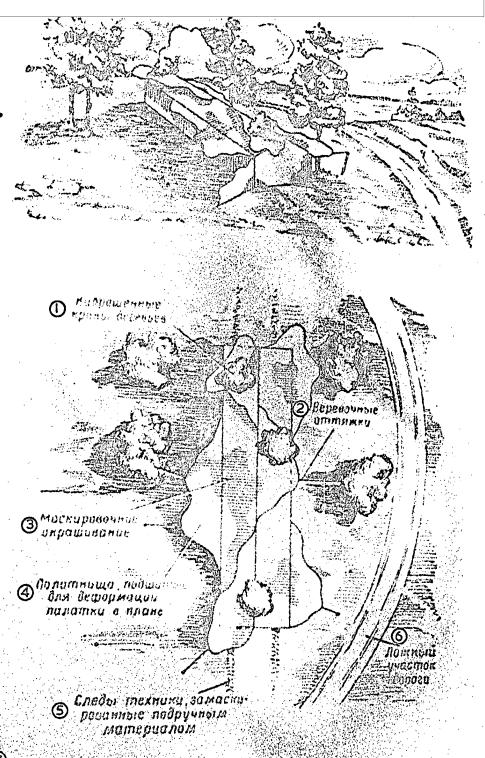


Рис. 14. Маскировка утеплительной прястки для проверки ракет леформирующими козырыезми и прущеобатинстым окращиванием

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SKETCH 14

CAMOUFLAGE OF A WARMING TENT FOR CHECKOUT OF THE MISSILES BY CHANGING THE OUTLINE WITH LIGHT OVERHEAD TRENCH COVERS AND LARGE PATCHES OF COLORING

- (1) Tree crowns put on top
- (2) Guy ropes
- (3) Camouflage coloring
- (4) Panels sewed on to change the outline of the tent
- (5) Tracks of the equipment camouflaged with locally available materials
- (6) Dummy section of road
- (7) Sketch 14. Camouflage of a warming tent for checkout of missiles by changing the outline with light overhead trench covers (kozyrek) and by painting large patches.

SKETCH 15 Козловой кран **Огрунтавой лафет** YKPHMUE рубленные вершины деревьев или макеты проп деревьев, подвешенные и тэжу из 2-4 проеплии ФЗ мм

Рис. 15. Скрытие пункта монялжа и перегрузки ракет подвеской крои деревьев

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 		SKETCH 15	
:	COL	CEALMENT OF A MISSILE ASSEMBLY AND TRANSLOADING	3
		POINT BY SUSPENDING TREE CROWNS	-
	(1)	Gantry crane	
	(2)	Cross-country carriage	
	(3)	To the shelter	
! !	(4)	Sawed-off tree tops or mockup tree crowns suspon 2 to 4 cables of 3 mm diameter stretched or	ended verhead.
	(5)	Sketch 15. Concealment of a missile assembly transloading point by suspending crowns.	and ree
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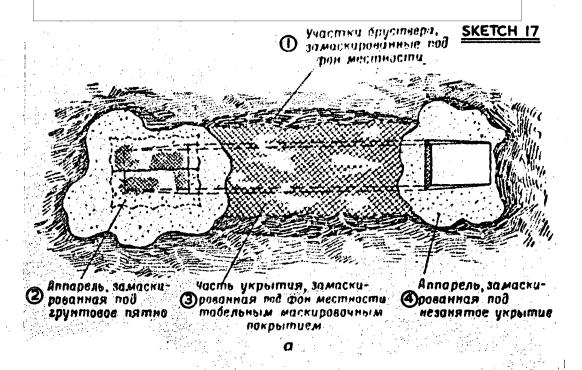
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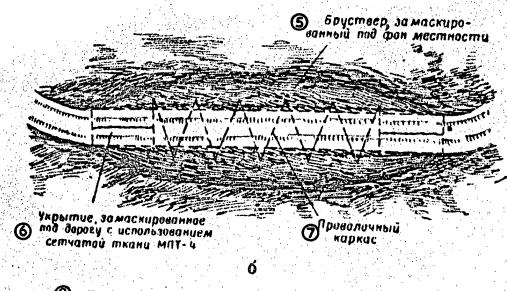
SKETCH 16

CAMOUFLAGE OF A MISSILE ASSEMBLY AND TRANSLOADING POINT IN AN INHABITED LOCALITY

- (1) Gantry crane
- (2) Guy lines
- (3) Unit of the camouflaged dummy that can be dismantled during the erecting of the crane.
- (4) Netting MPT-4 with paint to break up the outline
- (5) Simulated coloring of the camouflaged dummy
- (6) Sketch 16. Camouflage of a missile assembly and transloading point in an inhabited locality

Note: The frame of the camouflaged dummy is made up of metal or wooden posts 4.5 meters high, cable or rope braces and guys. The outer walls of the camouflaged dummy are formed to open or be extended like a curtain.





В Рис. 17. Маскировка укрытий котлованного типа:

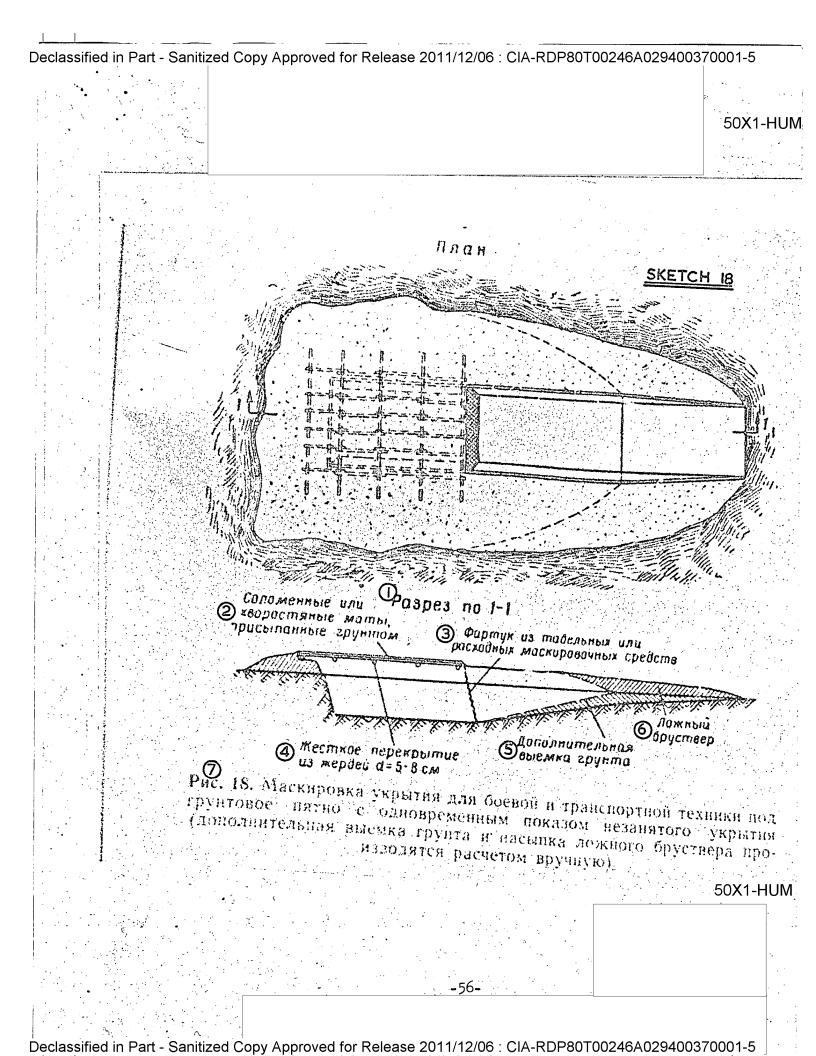
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SKETCH 17

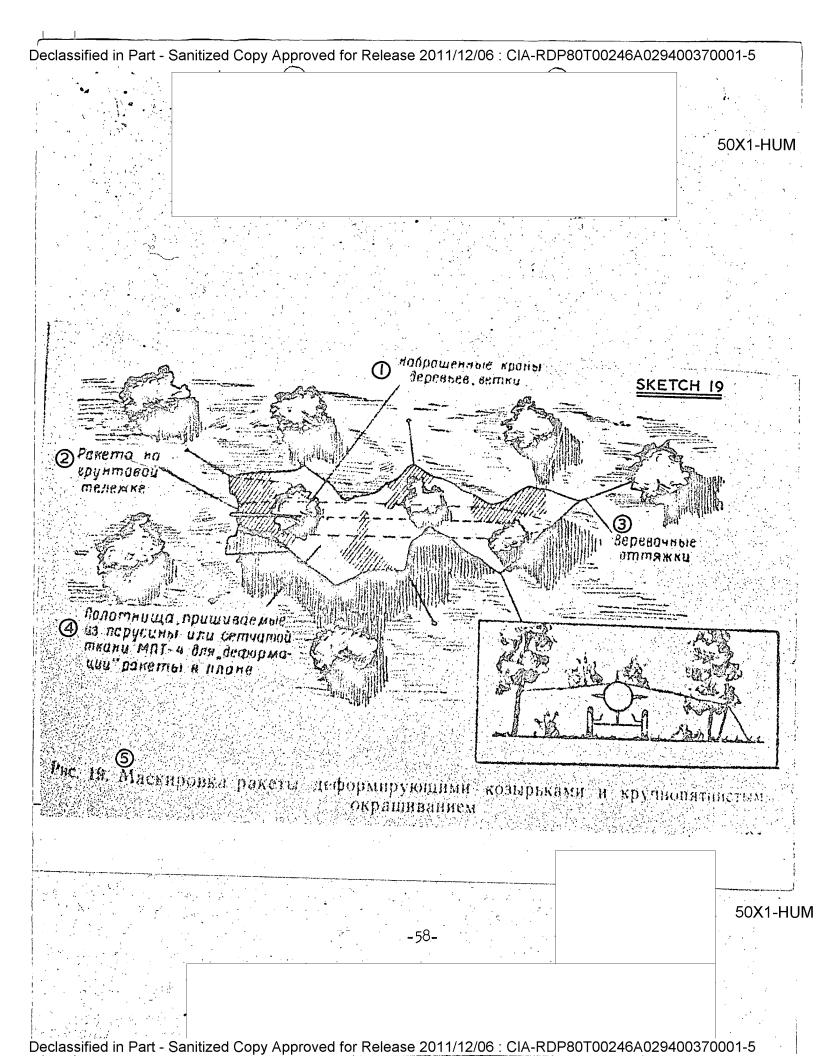
CAMOUFLAGE OF A DUGOUT TYPE OF SHELTER

- (1) Parts of the parapet camouflaged as the background of the terrain
- (2) Approach ramp camouflaged as a scar
- (3) Part of the shelter camouflaged as the background of the terrain using TOE camouflage covering
- (4) Approach ramp camouflaged as an unoccupied shelter
- (5) Parapet, camouflaged as the background of the terrain
- (6) Shelter, camouflaged as a road using MPT-4 netting
- (7) Wire frame
- (8) Sketch 17. Camouflage of a dugout type of shelter:
 - a As a ground scar and an unoccupied shelter;
 - b As a road.



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L			SKETCH 18		
		EQUIPMENT	D SHELTER FOR COMBA DISGUISED AS A GROU E SHOWING AN UNOCCU	UND SCAR, AT THE	
	(1)	Cross-secti	on between points i	numbered 1	
	(2)	Straw or br	ushwood mats sprink	kled with soil	
	(3)	Apron made	of TOE or expendabl	le camouflage mat	erials
	(4)	Rigid overh in diamter	ead cover made with	n poles, 5-8 cms.	
	(5)	Additional	excavation of the	ground	
	(6)	Dummy parap	et		
	(7)	Sketch 18.	Camouflaged shelted equipment disguised same time showing (Additional excaval spreading of soil carried out manual	ed as a ground sca an unoccupied sho ation of the ground for the dummy par	ar, at the elter. nd and
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SKETCH 19

CAMOUFLAGE OF MISSILE BY CHANGING THE OUTLINE WITH LIGHT OVERHEAD TRENCH COVERS AND BY PAINTING OF LARGE PATCHES

- (1) Crowns of trees and branches put on top
- (2) Missile on a cross-country carrier
- (3) Guy ropes
- (4) Panels made of canvas or MPT-4 netting to change the outline of the missile.
- (5) Sketch 19. Camouflage of missile by changing the outline with light overhead trench covers and by painting large patches.

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	*			<u> </u>	SKETCH 20		· · · · · · · · · · · · · · · · · · ·	
	4	A MISSIL	E ON	THE MOV	E DISGUIS	ED AS	A VEHICLE CO	YVOY
((1)	Side vi	ew			v		
((2)	AT - T				,		
. ((3)	Cross-c	ount	ry carri	ler			
((4)	The fra	me c	overed w	vith canva	s or l	MPT-4 netting	
((5)	Camoufl	age	coloring	,		· · · · · · · · · · · · · · · · · · ·	
((6)	View fr	om a	bove				
((7)	Tree cr	owns			*	•	
((8)	Dummy v	ehic	le cabs				
((9)	Sketch	20.		le on the convoy.	move	disguised as	a.
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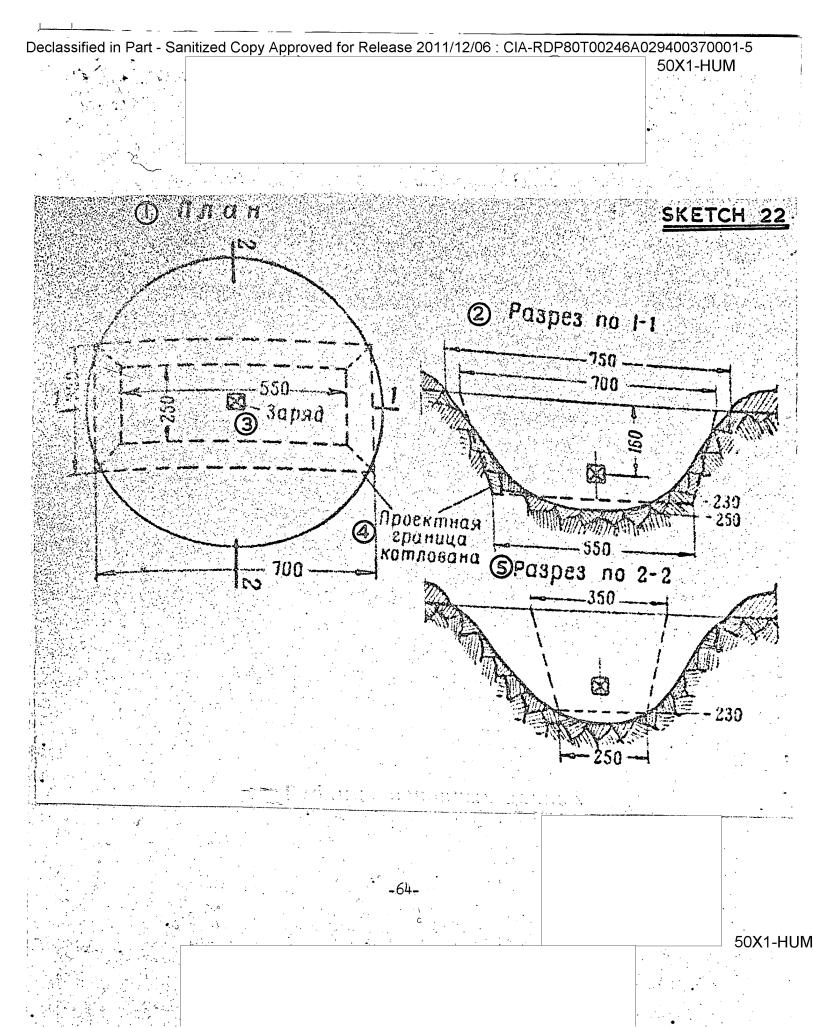
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SKETCH 21

A MISSILE BEING TRANSPORTED DISGUISED AS A LOAD OF LUMBER

- (1) Side view
- (2) Cross-country carrier
- (3) The frame covered with vanvas or MPT-4 netting
- (4) View from above
- (5) Shield of boards 15 x 2 cm

 To simulate the transportation of round timber, the shields are made up of thin slabs
- (6) Sketch 21. A missile being transported disguised as a transport of lumber.



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THE CONSTRUCTION OF A PIT FOR A LIGHT TYPE DUGOUT SHELTER WITH THE USE OF EXPLOSIVES

- (1) Plan
- (2) Cross-section between points numbered 1
- (3) Charge
- (4) Planned boundary of pit
- (5) Cross-section between points numbered 2

Table of Basic Data

	Categories of soil			
Designation of data	v	VI-VII	VIII-X	
Depth of excavation of hole in meters	1.7	1.7	1.7	
Expenditure of explosives for pit in kilograms	65	95	110	
Labor expenditure for work on pit, man-hours:	·			
Preparation for the explosion Manual finishing off work Total	1.5 27.5 29	5 44 49	7 60 67	

Categories of soil: V - stony ground, hard chalk;

VI-VII - friable rock (razbornaya skala); soft limestone; clay sandstone, badly cracked;

VIII-X - medium and hard limestones, granite, and others.

